इंटरनेट मानक

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Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

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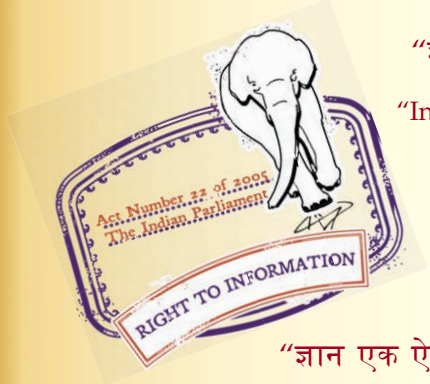
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 7312 (1993): Welded and seamless steel dissolved acetylene gas cylinders [MED 16: Gas Cylinders]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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भारतीय मानक

वेल्ड किए तथा जोड़ सहित इस्पात के घुली एसिटिलीन के गैस सिलिंडर — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

WELDED AND SEAMLESS STEEL DISSOLVED ACETYLENE GAS CYLINDERS — SPECIFICATION

(Second Revision)

UDC 621·642·02 : [669·15-194·2] : 662·766

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 1993

Price Group 7

Gas Cylinders Sectional Committee, HMD 16

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Gas Cylinders Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

This standard was first printed in 1974 when the manufacture of acetylene cylinders had not commenced in India. This standard was revised in 1982 when the manufacture of acetylene cylinders had commenced in India. Also, at the international level, ISO 3807 'Dissolved acetylene cylinders — Basic requirements' has been published. First revision was aligned with ISO 3807 and included seamless cylinders also.

This revision is being undertaken to incorporate the following:

a) Modification in the definition of dissolved acetylene cylinder.

b) Inclusion of crushing strength for the porous mass.

c) Inclusion of bonfire test.

d) Modification of method of measurement of the gap between porous mass and the shell.

e) To refer the test methods specified in IS 3196 (Part 3) : 1991 'Welded low carbon steel gas cylinder exceeding 5 litre water capacity for low pressure liquefiable gases: Part 3 Methods of test (*fourth revision*)'.

The bonfire test was adopted from Australian Standard No. B. 189-1962 'Welded capsule type steel cylinders for acetylene' published by Standards Association of Australia.

Manufacture and filling of dissolved acetylene gas when contained in cylinders is regulated by the Gas Cylinder Rules, 1981 of the Government of India. This specification has been prepared in consultation and agreement with the concerned statutory authorities.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

The relevant SI units and the corresponding conversion factors are given below for guidance:

Pressure 1 Pa (Pascal) = 1 N/m^2

1 kgf/mm^2 = 9·806 65 MPa

AMENDMENT NO. 1 DECEMBER 1994
TO
IS 7312 : 1993 WELDED AND SEAMLESS STEEL DISSOLVED ACETYLENE GAS CYLINDERS — SPECIFICATION

(Second Revision)

(*Page* 4, *clause* **9.2**) — Add the following new clause after clause **9.2**:

'**9.3 Valves**

The valves for the cylinders shall conform to IS 3224 : 1979. The cylinders of seamless construction according to **6.2.3** shall be fitted with valves having safety device. However, cylinders for marine application shall not have any safety device.'

(*Page* 9, *clause* **20.6**) — Insert the following at the begining:

'Bonfire test shall be conducted oncylinders having safety devices according to **10.2**'.

(*Page* 12, *Annex A*, *last entry*) — Substitute '13497' *for* '13479'.

(*Page* 13, *clause* C-3.1, *second line*) — Substitute '**19.2.3**' *for* '19.3.1'.

(HMD 16)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 MARCH 2002
TO
IS 7312 : 1993 WELDED AND SEAMLESS STEEL DISSOLVED ACETYLENE GAS CYLINDERS — SPECIFICATION

(Second Revision)

(*Page* 7, *clause* **19.2.4**) — Insert the following new clause after **19.2.4**:

19.2.5 If sample fails in requirement of crushing strength of the porous mass and if the inspecting authority considers that the failure was due to an error in carrying out the test, a fresh test shall be done on a test piece taken from the same cylinder. The defective test shall be ignored, but, otherwise, the following procedure shall be adopted:

The test shall be repeated on the same cylinder and in addition, one cylinder shall be drawn at random from the same control unit and tested. If both the samples satisfy the test requirements, the batch shall be accepted. If any of the samples fails, the particular control unit shall be rejected and cylinders of that particular control unit shall be rendered unserviceable for holding the gas.

From the rest of the batch, one cylinder from each control unit shall be selected at random and cylinders shall pass or fail, control unit wise depending upon the results of crushing strength as laid down in **19.2.4**. Cylinders of rejected control unit shall be rendered unserviceable for holding the gas and shall be destroyed.

(MED 16)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 3 FEBRUARY 2007
TO
IS 7312 : 1993 WELDED AND SEAMLESS STEEL DISSOLVED ACETYLENE GAS CYLINDERS — SPECIFICATION

(Second Revision)

(*Page* 1, *clause* **3.2**, *first line*) — Substitute 'portable pressure vessels' *for* 'portable vessel'.

(*Page* 1, *clause* **3.5**) — Insert the following new clause after **3.5**:

'**3.6 Maximum Acetylene Content** — Maximum mass of acetylene in kilogram, the cylinder is designed to contain.'

[*Page* 11, *clause* **21.2**(h)] — Substitute 'Maximum settled working' *for* 'Maximum Working'.

[*Page* 11, *clause* **21.2**(p)] — Insert the following after **21.2**(p):

'q) Weight of solvent in kilogram.'

[*Page* 11, *clause* **22**(h)] — Substitute the following for the existing:

'h) Weight of cylinder in item (g) plus weight of saturation gas, weight of solvent at atmospheric pressure and weight of valve, but not including valve cover, if any; and'.

(ME 16)

Reprography Unit, BIS, New Delhi, India

Indian Standard

WELDED AND SEAMLESS STEEL DISSOLVED ACETYLENE GAS CYLINDERS — SPECIFICATION

(Second Revision)

1 SCOPE

1.1 This specification covers the requirements for portable welded or seamless dissolved acetylene gas cylinders made of steel and having nominal water capacity within the range 0·5 litres and up to and including 130 litres. This standard lays down the requirements for the materials, design, manufacture, construction, tests and marking of these cylinders.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions in addition to those given in IS 7241 : 1981 shall apply.

3.2 Dissolved Acetylene Cylinder

A portable vessel having a valve and with or without safety devices, filled with monolithic porous mass, a solvent for the storage of dissolved acetylene and at least sufficient quantity of acetylene to saturate acetone (*see* IS 170 : 1986) as solvent at atmospheric pressure and at a temperature of 15°C.

3.3 Maximum Working Pressure

The gauge pressure of the cylinder charged with acetylene at 15°C and is equal to 1 568 kPa (16 kgf/cm^2) when acetone is the solvent.

3.4 Tare

The weight of the cylinder defined in **3.2** including that of any valve protection permanently fixed directly to the cylinder, but excluding the weight of any removable valve cap.

3.5 Test Pressure

The internal pressure required for the hydrostatic stretch test of the cylinder shell before filling the porous mass. It is equal to 5 880 kPa (60 kgf/cm^2) for cylinders without fusible plug and 5 194 kPa (53 kgf/cm^2) for cylinders with fusible plug, when acetone is the solvent.

4 MATERIAL

4.1 The steel used in the manufacture of cylinders shall conform to Type 1 of IS 2041 : 1982 or IS 6240 : 1989 or IS 10787 : 1984. For seamless cylinders, **6.2.3** may be referred.

4.1.1 Suitable low carbon steel other than those given in **4.1** may be used with the prior permission of the statutory authority. In such a case, the minimum specified value of yield strength of the steel specification shall be used for the purpose of calculating the wall thickness of the cylinder. Such a steel shall be certified by the steel maker to be other than of rimming quality, suitable for pressing or drawing with acceptable non-ageing properties and shall be fully killed.

4.1.2 The cylinder manufacturer shall obtain and provide certificate of cast (heat) analysis of the steels supplied for the construction of gas cylinders and establish means to identify the cylinders with the casts of steel from which they are made.

4.2 The bung/valve pad shall be hot forged from rolled steel either conforming to class 1 A or 2 of IS 1875 : 1992 or IS 226 : 1975 or IS 2062 : 1984 or IS 7283 : 1992 or IS 9550 : 1980.

4.3 The material used for footring shall conform to Grade 0 of IS 1079 : 1988 or any other steel equivalent or superior qualities.

5 GENERAL

A fully dimensioned sectional drawing of the cylinder, together with design-calculations and scheme of manufacture, shall be submitted by the manufacturer to the inspecting authority for final approval by statutory authority.

6 DESIGN

6.1 A cylinder shall be of welded construction having a cold drawn or hot drawn cylindrical portion with hemispherical, ellipsoidal or torispherical ends welded to it, or two halves of

cold or hot drawn and circumferentially welded together, or any other construction approved by the statutory authority.

6.2 The calculation of the thickness of pressure parts of the gas cylinder is related to the minimum value of yield strength of the material specified in **4.1** and **4.1.1** and the test pressure.

6.2.1 The agreed finished thickness shall not be lower than that calculated from the following formulae:

a) For cylindrical portion, greater of the following two:

1) $$t = \frac{P_h D_o}{200 \times 0{\cdot}8 J R_e + P_h}$$

$$= \frac{P_h D_i}{200 \times 0{\cdot}8 J R_e - P_h}$$

OR

2) $$t = 0{\cdot}136 \times \sqrt{D_o}$$

b) For torispherical part or end (*see* Fig. 1A) :

$$t = \frac{P_h D_o}{200 \times 0{\cdot}8 J R_e + P_h} \times \frac{KZ}{5}$$

c) For semi-ellipsoidal part or end (*see* Fig 1 B):

$$t = \frac{P_h D_o}{200 \times 0{\cdot}8 J R_e + P_h} \times \frac{K(0{\cdot}65 + 0{\cdot}1 K)}{4}$$

where

t = Calculated minimum wall thickness of cylindrical shell in mm excluding any additional thickness to resist influences other than those of internal pressure and of external forces due to normal handling (*see* **8.4**);

P_h = Hydrostatic test pressure above atmospheric in kgf/cm²;

D_i = Inner diameter in mm;

D_o = Outer diameter in mm;

J = Weld joint factor;

= 1·0 if each weld is to be fully radiographed;

= 0·9 for cylinders with circumferential seam or seam only (not radiographed);

= 0·9 for cylinders with seams other than circumferential which are spot radiographed in accordance with **13.2**;

R_e = Yield strength (minimum value specified in **4.1** and **4.1.1**) in kgf/mm²;

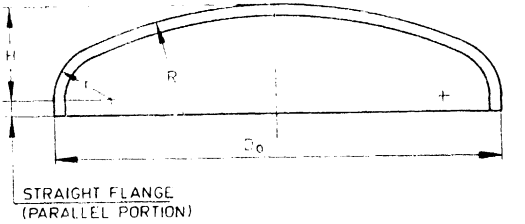
H = Depth of dishing, in mm;

K = The ratio D_o/H;

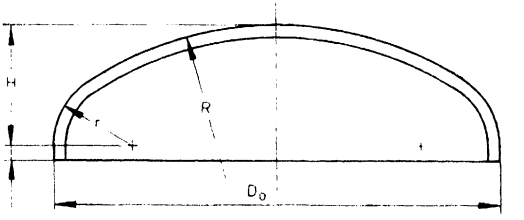
R = Dishing radius, in mm ($R \leqslant D_o$);

r = Knuckle radius, in mm ($r \geqslant 0{\cdot}1 D_o$); and

$$Z = \frac{\frac{20r}{R} + 3}{\frac{20r}{R} + 1}$$



1A Torispherical End



1B Semi-Ellipsoidal End

FIG. 1 TORISPHERICAL AND SEMI-ELLIPSOIDAL ENDS

6.2.1.1 For hemispherical ends or parts, the minimum calculated thickness need not exceed that of the cylindrical portion of the cylinder.

6.2.1.2 When concave bottoms are applied (*see* Fig. 2) the design shall be such that the following minimum values are guaranteed by the cylinder manufacturer:

$t_1 = 2t$, $t_2 = 2t$, $h = 0{\cdot}1\ D_0$ and $r = 0{\cdot}075\ D_0$.

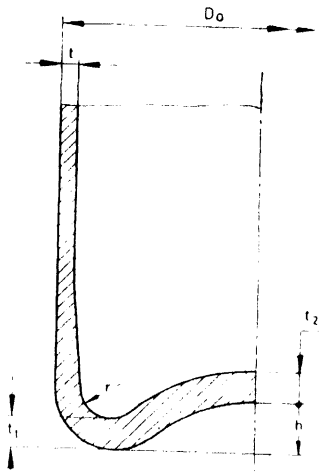


FIG. 2 CONCAVE BOTTOM

6.2.2 The thickness of the shell shall not be less than 2·5 mm for cylinders up to and including 10 litres water capacity and not less than 3·5 mm for cylinders above 10 litre water capacity. The actual thickness of the end or dished part shall not be less than the thickness of the cylindrical portion.

6.2.3 The cylinders of seamless construction shall conform to IS 7285 : 1988 regarding material, design, manufacture, heat treatment, fitting and testing. The serial number punched on the seamless shell by its manufacturer shall continue as the serial number of the dissolved acetylene gas cylinder. No fusible plug or safety device shall be fitted on the body of seamless cylinders.

6.3 Before the design is finally approved, the statutory authority may require one or more prototype cylinders to be subjected to various tests as specified in this specification or such other tests, as authority deems fit.

7 WELDING

7.1 The cylinder shall be welded by any suitable fusion welding method and shall conform, as for welding procedure and welder's performance qualifications, to the requirements of IS 2825 : 1969 or IS 817 : 1966.

7.2 Before welding, the plates to be joined shall be free from scale, grease, oil and dirt. Before the cylinders are closed, longitudinal welds, wherever used, shall be visually examined from both sides to ensure that the welds are satisfactory.

7.3 Welds shall have an even finish and shall merge into the parent material without undercutting or abrupt irregularity.

7.4 Welding consumables used shall be such that the desired properties of the weld are obtained and the physical values of the welded metal are not lower than the specified values of the parent metal.

7.5 The chemical composition of the weld metal shall be compatible with that of the parent metal.

8 MANUFACTURE

8.1 The number of longitudinal seams in the welded cylinder shall not exceed one and the number of circumferential seams shall not exceed two.

8.2 When the welded cylinder contains a longitudinal seam, the edges of the plate forming the longitudinal joint of the shell shall be rolled or formed by pressure, not by blows, to the required curvature.

8.3 The end or dished part shall be of hemispherical, semi-ellipsoidal or torispherical shape. These shall be either forgings, suitably thickened at the neck, or pressed ends with provision for welding to it a bung/valve pad to take the valve. The end shall have a cylindrical skirt or parallel portion of minimum length 20 mm or three times the shell thickness, whichever is greater.

8.4 Agreed Finished Thickness

The agreed finished thickness shall not be less than the minimum calculated wall thickness obtained by the application of formulae given in **6.2.1** at any point and at any transverse section of the cylindrical portion. Additional thickness may also have to be provided to cover corrosion allowance and stresses due to horizontal acceleration and retardation during transportation. The amount of this allowance shall be as agreed to between the manufacturer and the purchaser.

8.5 Examination of Cylinders Before Closing-in Operation

Cylinders shall be examined for wall thickness, before the closing-in operation, circularity of the cylindrical shell and the skirt portion of ends, external and internal surface defects, the profile regularity of the ends, offset at the joints, and straightness. The manufacturer shall assure himself that the wall thickness is not less than the agreed finished thickness at any point.

8.5.1 *Circularity*

The out-of-roundness of the cylindrical shell shall be limited to such a value that the difference between the maximum and the minimum outside diameter in the same cross section is not more than one percent of the mean of these diameters.

8.5.2 *Surface Defects*

The internal and external surfaces of the cylinder shall be free from defects which will adversely affect the safe working of the cylinder.

8.5.3 *Profile Regularity*

The contour of the dished end shall not deviate from the approved dimensions by more than 1·25 percent of the nominal diameter in respect of radial dimensions and by more than one percent in respect of axial dimensions. Such deviations shall not be abrupt changes and shall be outside the specified shape.

8.5.4 *Offset at the Joint*

The misalignment measure at the surface of the plates shall not exceed 10 percent of the nominal plate thickness. Where the thickness of the ends exceeds the shell thickness by more than 25 percent, the abutting edges shall be reduced by a smooth taper extending for a distance of four times the offset between the abutting edges.

8.5.4.1 Before any welding is commenced, it shall be ascertained that the chamfered edges are in alignment and that the defects in alignment at the surface of the plates are less than:

a) For plates of thickness 5 mm or less — $t/6$ for a longitudinal seam and $t/4$ for circumferential seam, subject to a maximum of 1 mm.

b) For plates over 5 mm in thickness — It shall be ascertained that the prepared edges are in alignment to meet the requirements of the welding process and that the defects in alignment at the surface of the plates are not more than:

1) 10 percent of the nominal plate thickness with a maximum of 3 mm for longitudinal joint. However, for plates up to and including 10 mm thick a misalignment of 1 mm is permitted.

2) 10 percent of the maximum nominal plate thickness plus 1 mm with a maximum of 4 mm for circumferential joints.

NOTE — Welds made with backing strips require better alignment than specified above.

8.5.5 *Straightness*

Unless otherwise shown on the drawing, the maximum deviation of the shell from a straight line shall not exceed 0·3 percent of the cylindrical length.

9 VALVES AND VALVES PAD

9.1 The valve connection shall consist of a welded or brazed pad/bung, and shall be threaded to suit the type of valve specified in IS 3224 : 1979. If welding is adopted, two runs of welding shall be employed for bungs which have a backing pad (either on the outside or one on the outside and one on the inside). In the case of bungs without backing pad, one run of welding shall be given on the inside and one on the outside. In the case of bungs without backing pad but having a chamber on the bung providing compound weld joint (butt and fillet) between bung and top dished end, the same may be welded only on the outside with two runs of weld.

9.2 Valve Protection

The valve shall be protected by a stout metal cap perforated for ventilation and of thickness not less than 3·5 mm, screwed on to the neck, or in any other manner approved by the statutory authority.

10 FITTINGS OTHER THAN VALVES

10.1 Footring

The footring, where fitted as a separate fixture to the bottom end of the cylinder, shall be at least 20 mm away from the circumferential weld. The thickness of the sheet from which the footring is made shall not be less than the calculated wall thickness of the cylinder body. The footring may be intermittently welded. In case, the bottom edge is curled, the curling shall be inwards to facilitate safe handling. It shall be provided with holes for ventilation, and if curled, drainage holes to be provided to avoid corrosion. The maximum permissible deviation from the vertical shall not exceed 1°. Footrings

shall be sufficiently strong and made of steel compatible with that of the cylinder prescribed in IS 1079 : 1988, or of other steel having equivalent properties. The bottom of the footring shall not be less than 8 mm below the outside bottom of the cylinder shell for cylinders up to 34 litres nominal water capacity. For cylinders of more than 34 litres nominal water capacity and up to 50 litres nominal water capacity, this value shall be minimum 15 mm and for cylinders exceeding 50 litres nominal water capacity, this value shall be minimum 25 mm.

10.2 Safety Devices

10.2.1 Fusible plug provided for welded cylinders shall conform to IS 13497 : 1992.

10.2.2 Safety devices shall be positioned on the bung/valve pad of the welded cylinders on both sides of the valve shank opening.

11 HEAT TREATMENT

All cylinders shall be efficiently normalized, or stress relieved in accordance with the steel maker's recommendation, after manufacture and completion of all welding (including that of attachments) and before hydrostatic test is applied, by any suitable method at a temperature in excess of 600°C. Liquid quenching is not permissible. A complete record of the heat treatment cycle shall be maintained.

12 INSPECTION

12.1 General

12.1.1 The inspecting authority shall have free access, at all reasonable time to that part of the manufacturer's works engaged in the order. They shall also be at liberty to inspect the fabrication at any stage and to reject any cylinder, or part of a cylinder, that does not comply with the requirements of this standard.

12.1.2 The manufacturer shall supply the man power and equipment for such inspection and tests as are required and for any additional checks which may be agreed between the inspecting authority and the manufacturer.

12.1.3 The visual inspection of cylinders shall be carried out and the limits of defects shall be as given in IS 9639 : 1980.

12.2 Inspection of Components

12.2.1 All pressings, halves and cylindrical shells shall be examined for surface defects before any seam is welded. If there are defects which, in the opinion of the inspecting authority, would be detrimental to the sound construction of the container, the pressing or shell shall be rejected.

12.2.2 At the discretion of the inspecting authority, 2 percent or more of the pressings, halves and the cylindrical shells shall be selected at random to represent all batches of material used for the manufacture of the cylinders, and these batches shall be examined for minimum thickness before any seam is welded.

12.2.3 Should any pressing, half or shell be less than the minimum specified thickness, the whole output from the relevant batch of material shall be examined for minimum thickness, and any pressing or shell which is less than the specified minimum thickness shall be rejected.

12.2.3.1 For the purpose of this clause 'batch of material' is defined to mean pressings or cylindrical shells manufactured in a continuous production run.

13 RADIOGRAPHIC EXAMINATION

13.1 Radiographic examination with X-ray, when required, shall conform to the techniques and acceptability criteria set forth in the relevant Indian Standards. For general guidance, reference may be made to IS 1182 : 1983, IS 2595 : 1978, IS 3657 : 1978 and IS 4853 : 1982 and **8.7** of IS 2825 : 1969. The radiographic technique used shall be sufficiently sensitive to reveal a defect having a thickness equal to 2 percent of the combined thickness of the weld and the backing material.

13.2 Spot Radiography (*see* definition of *J* under **6.2.1**)

13.2.1 One out of every 50 consecutive cylinders from continuous production shall be taken at random for spot radiography.

13.2.2 In addition, after a change in the type or size of cylinder or the welding procedure (including machine settings), or after a break in the production exceeding four hours, the first cylinder welded shall be taken for spot radiography.

13.3 The film density shall be up to 3 and in no case shall not be less than 1·7.

13.4 Refer **10** of IS 3196 (Part 3) : 1991 for testing details of radiography.

14 CHECKING OF WATER CAPACITY

The water capacity of the cylinders shall be checked. This shall be done by weighing or by volumetric method. Water capacity of the cylinder shall have a tolerance of $^{+3}_{0}$ percent on the declared value.

15 HYDROSTATIC TESTS

15.1 Hydrostatic Stretch Test

Each heat treated cylinder shall be subjected to a hydrastatic stretch test. No pressure greater

than 80 percent of the test pressure shall have been applied to the cylinder before the test.

15.1.1 Hydrostatic stretch test shall be carried out according to **6** of IS 3196 (Part 3) : 1991 using 'non-jacket' method.

15.1.2 Permanent volumetric expansion suffered by the cylinder due to application of test pressure shall not exceed 7·5 percent of the total volumetric expansion at the pressure.

15.2 Hydrostatic Test

Cylinder which passes the test given in **15.1** shall be subjected to hydrostatic test. During the hydrostatic test, the pressure shall be increased gradually till 95 percent of the test pressure is reached. After this pressure is reached, the external surfaces of the cylinder are dried and the pressure shall be retained for a period of not less than 30 seconds. Any reduction in pressure noticed during this retention period or any leakage or visible bulge or deformation shall be treated as a case of failure in the test.

15.2.1 The values of hydrostatic test pressure shall be in accordance with **3.5**.

15.2.2 Hydrostatic test shall be carried out according to 7 of IS 3196 (Part 3) : 1991.

15.2.3 The tests specified in **15.1** and **15.2** may be carried out at the same time.

16 PNEUMATIC LEAKAGE TEST

16.1 Subsequent to hydrostatic tests, each cylinder, after it has been dried, shall be tested for leakage by subjecting to air pressure of not less than 3 920 kPa (40 kgf/cm^2) for a period of one minute while immersed in water and shall show no leakage.

16.1.1 Alternatively any other method approved by the statutory authority may be used.

16.1.2 Pneumatic leakage test shall be carried out according to **8** of IS 3196 (Part 3) : 1991.

17 BURSTING TEST

17.1 One cylinder selected at random from a batch of 403 hydrostatic test passed cylinders shall be subjected to a hydrostatic pressure till it bursts.

17.2 Bursting test shall be carried out according to **9** of IS 3196 (Part 3) : 1991.

17.3 The nominal Hoop stress value of f_h shall be not less than 0·95 of the minimum specified tensile strength of the material of the cylinder.

The cylinder shall burst without fragmentation. During burst test in case leakage starts from any welding before fracture or before achieving required hoop stress, the specimen shall be discarded and fresh test specimen shall be taken.

Fracture shall not occur in the weld in the direction of the circumferential or longitudinal seam. The fracture shall also not occur in the direction parallel to circumferential weld within 10 mm from the edge of the circumferential weld.

18 ACCEPTANCE TESTS

18.1 For every batch of 202 or less heat-treated and finished cylinders, one test cylinder shall be selected at random, and the various acceptance tests shall be carried out on test specimens taken from this cylinder.

18.1.1 Number of test specimens and method of testing shall be in accordance with **5** of IS 3196 (Part 3) : 1991.

18.1.2 The percentage elongation and yield strength, wherever applicable, and tensile strength thus determined shall not be less than the respective requirements for the material specified in **4**.

18.1.3 The bend test specimen having cracks or any other open defects, which exceed 3 mm, measured in any direction on the convex surface of the specimen, shall be treated as a failure.

18.1.4 The weld shall show a good penetration and absence of lack of fusion.

18.1.5 The thickness shall not be less than the calculated thickness.

19 TECHNICAL REQUIREMENTS FOR ACETYLENE, POROUS FILLING MASS AND SOLVENT

19.1 Acetylene

19.1.1 The quantity of the acetylene stored in the cylinder (excluding the acetylene required to saturate the solvent at atmospheric pressure and a temperature of 15°C) shall not exceed the amount authorized for the cylinder and permanently marked on the cylinder.

19.1.2 When the cylinder has been charged with acetylene and the pressure has reached equilibrium the maximum gauge pressure in the cylinder with acetone as the solvent shall not exceed 1 568 kPa (16 kgf/cm^2) at 15°C.

19.2 Porous Filling

19.2.1 Every cylinder shall be filled with a porous filling approved by the statutory authority and shall be effectively vibrated while filling the porous mass.

19.2.2 The porous filling material shall be of such structure that it will not disintegrate or sag when wet with solvent or when subjected to

normal service. The porous filling material shall be uniform in quality and free of voids, except that a well drilled into the firing material beneath the valve is permissible provided that the well be filled with a material of such type that the functions of the filling material are not impaired. Overall shrinkage of the filling material is permissible provided that the total clearance between the cylinder shell and filling material, does not exceed 0·5 percent of the respective diameter or length but in no case of exceed 3·2 mm measured diametrically and longitudinally and that such clearances do not impair the functions of the filling material.

19.2.3 The porosity of the porous filling shall be in the range of 75 to 92 percent as determined by the method prescribed in Annex B.

19.2.4 The crushing strength of the porous filling shall be 2 156 kN/m² (22 kgf/cm²) minimum as determined by the method prescribed in Annex C.

19.3 Solvent

19.3.1 Acetone, if used, shall comply with the requirements of IS 170 : 1986. The quantity of acetone including the gas in solution shall be such that the cylinder meets the requirements of additional tests specified in **20.**

19.3.2 The maximum amount of acetone filled in a cylinder shall be proportioned to the porosity of the porous mass and the volumetric capacity of the cylinder in the following scale:

Porosity Percent	*Maximum Acetone Content in Percent of Water Capacity of Cylinder, by Volume*	
	For Cylinders Having Nominal Water Capacity not Exceeding 9 Litres	For Cylinders Having Nominal Water Capacity Exceeding 9 Litres
Over 75 up to and including 80	34·8	36·2
Over 80 up to and including 83	37·1	38·6
Over 83 up to and including 87	38·5	40·0
Over 87 up to and including 90	38·5	42·0
Over 90 up to and including 92	41·8	43·4

20 PROCEDURE FOR TYPE TESTING OF DISSOLVED ACETYLENE CYLINDERS

20.1 Request for Approval

20.1.1 A request for the approval of acetylene cylinders may cover a range of different constructions and sizes, provided all these contain the same porous mass. A separate application shall be made for each type of declared specification of the raw material and manufacturing process.

Cylinders for test shall be selected as follows:

a) For cylinders with a nominal water capacity above 50 up to and including 160 litres, the inspecting authority shall select cylinders for test with a capacity considered to be representative of the size under consideration;

b) For cylinders with a nominal water capacity between 10 and 50 litres, tests shall be on the smallest and the largest cylinders of every range proposed by the manufacturer having the same acetylene/solvent ratio: and

c) For cylinders with a nominal water capacity below 10 litres, no test need be carried out on cylinders having an acetylene content of not more than 90 percent of the equivalent proportional content used in approved cylinders of 10 litres or greater water capacity. For cylinders having an acetylene content greater than 90 percent, tests shall be carried out on cylinders of a nominal water capacity, representative of the size under consideration.

20.1.2 Each request for approval shall include the following information:

a) A schedule of the different constructions and sizes of acetylene cylinders which form the subject of the request for approval and which includes, for each size of cylinder, the following information:

   i) Nominal water capacity in litres;

   ii) Solvent to be used;

   iii) Mass of solvent in kilograms; and

   iv) Maximum mass of acetylene in kilograms;

b) A description of the porous substance, as it exits in the cylinder, which gives sufficient information to ensure reliable identification; and

c) A report on the porosity determinations carried out by the manufacturer on the test cylinders provided, according to the method given in Annex B, and a statement of the maximum and minimum limits of porosity within which the porous substance will be manufactured.

20.1.3 The request for approval shall be accompanied by a declaration from the manufacturer stating that in the event of approval, the production of the porous substance will be in accordance with the information given in the request for approval in **20.1.2**.

20.2 Submission of Cylinders for Test

20.2.1 Representative cylinders, selected by the appropriate authority, shall withstand successfully the appropriate type tests **20.3** and **20.4** prior to approval being granted to the request made by the manufacturer.

20.2.2 The cylinders shall be selected from the sizes specified in **20.1.1**. The inspecting authority after having studied the schedule provided, as specified in **20.1.2**, will ask the manufacturer to submit cylinders for test. These cylinders shall be complete with all accessories including the porous mass, solvent and saturation gas, unless otherwise specified by the inspecting authority.

20.2.3 The inspecting authority has the right to witness the filling of the porous mass and to select and determine the number of cylinders which are to be tested.

20.2.4 Cylinders of each size selected for test by the inspecting authority shall be tested as follows:

a) Not less than three cylinders shall be subjected to the elevated temperature test in accordance with **20.3**;

b) Not less than four additional cylinders shall be subjected to the vibration test as specified in **20.4** out of which one will be sectioned for examination while the remaining three cylinders shall be further subjected to drop treatment followed by backfire test specified as in **20.5**; and

c) One cylinder shall be tested for bonfire test specified in **20.6**.

20.3 Elevated Temperature Test

20.3.1 This test shall be carried out on cylinders which have been filled with solvent and charged with acetylene conforming to IS 308 : 1988 to the maximum content as prescribed by the manufacturer plus an overcharge of 5 percent acetylene.

20.3.2 Each cylinder shall be placed in a water bath, the mean temperature of which is maintained at 65 ± 2°C, until the pressure in the cylinder constant or the pressure curve shows that hydraulic pressure has developed.

20.3.3 If, during this test, the pressure curve indicates that hydraulic pressure has developed in the cylinder, or if the maximum pressure in the cylinder exceeds the cylinder test pressure, the cylinder has failed.

20.3.4 All cylinders selected are required to pass the elevated temperature test.

20.4 Vibration Test

20.4.1 Cylinders with saturation gas shall be subjected to vibration test.

20.4.2 The purpose of the test is to examine the behaviour of the porous substance in the cylinder under those conditions such as occurring during transportations. The test shall be carried out as detailed in **20.4.3**.

20.4.3 The cylinder with saturation gas shall be placed in a vertical position on an apparatus so arranged as to subject the cylinder to successive drops from a height of not less than 100 mm, so as to strike the end of the cylinder on a steel or cast iron surface solidity supported by a concrete foundation or equivalent. Cylinders shall be subjected to this drop 5 000 times consecutively.

20.4.4 The cylinder will then be sectioned longitudinally and the filling mass carefully examined. To meet the requirements of this test no appreciable setting or breaking up of the filling mass shall be noted after this treatment nor shall there be any voids in the filling material. The two halves so cut shall be photographed in full size.

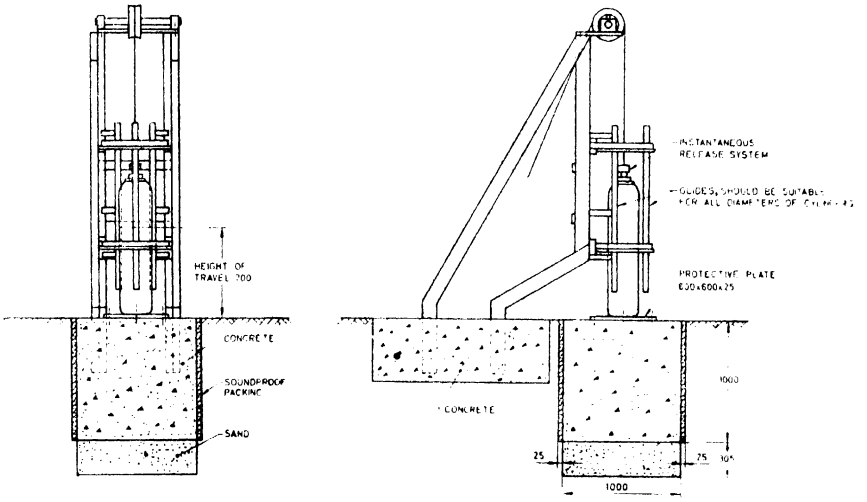
20.5 Backfire Test

20.5.1 *Drop Treatment*

20.5.1.1 Each cylinder, having been filled with the mass of solvent specified by the manufacturer and saturated with acetylene conforming to IS 308 : 1988 at atmospheric pressure shall be dropped 10 times without friction between the cylinder and the guides from a height of 0·70 m on to a concrete block covered with a protective plate similar to that in the apparatus shown in Fig. 3.

20.5.1.2 Each cylinder shall be fitted with a device that will prevent loss of cylinder contents during the drop treatment.

20.5.1.3 Any subsidence or other defect of the porous substance which has taken place during the drop treatment shall not be corrected before submitting the cylinders to the backfire procedure.



All dimensions in millimetres.

FIG. 3 A TYPICAL APPARATUS FOR DROP TREATMENT

20.5.2 *Backfire Procedure*

20.5.2.1 For the purpose of this procedure the cylinder shall be provided with a special outlet connection which connects the cylinder directly to an explosion tube similar to that shown in Fig. 4. The capacity of the explosion tube shall be 75 ml with an internal diameter of 30 mm terminating in a passage 4 mm in diameter with a length of 70 mm, connecting directly into the cylinder. The explosion tube shall be provided with the means of initiation consisting of a suitable wire, such as tungsten, 0·2 mm in diameter and 15 mm in length.

20.5.2.2 The cylinders fitted with the appropriate equipment shall be charged with acetylene, conforming to IS 308 : 1988, to the maximum acetylene content proposed by the manufacturer plus an overcharge of 5 percent, taking all necessary steps to purge the cylinder of non-soluble gases as far as is practicable. The explosion tube shall be purged of air and the accumulation of inert gases in the tube shall be prevented.

20.5.2.3 The cylinder shall be:

a) Stored horizontally for five days at a temperature between 15 and 20°C.

b) Placed vertically in water bath, maintained at a temperature of 35°C with a maximum variation of + 1°C for three hours except for cylinders below 10 litre water capacity in which case the heating time shall be one-and-a-half hours. The maximum pressure shall also be recorded.

c) Placed vertically in the firing position and fired when the pressure inside the cylinder has fallen to a value 3 to 4 percent below the maximum pressure attained in the cylinder during its heating as described in (b) above. Adequate precautions against the possibility of a cylinder bursting shall be taken in carrying out this procedure.

20.5.2.4 A cylinder has failed the test if it bursts, or if there is any release gas from safety devices, within 24 hours backfire of the test.

20.5.2.5 All cylinders selected are required to pass the backfire test. The cylinders passing the type test shall be destroyed.

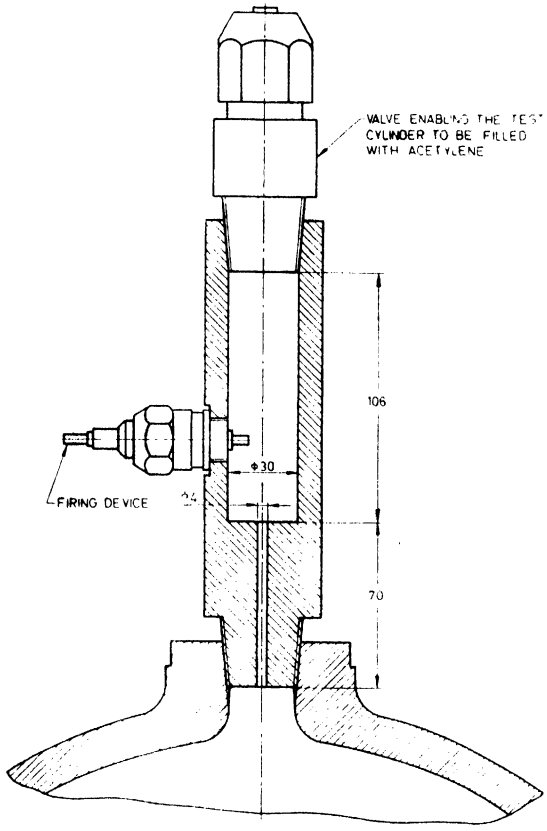
20.6 Bonfire Test

The fully charged cylinder, connected to a remotely located recording or continuously observed pressure gauge which can be observed during the course of the test, shall be placed horizontally on a rack. While on the rack the cylinder shall be subjected to the fire resulting from the combustion of the following pieces of dry, yellow pine, or similar timber:

80 pieces of 25 × 25 × 300 mm

40 pieces of 25 × 50 × 750 mm

40 pieces of 25 × 50 × 1 000 mm



All dimensions in millimetres.

FIG. 4 EXPLOSION TUBE FOR BACKFIRE TEST

The pieces of timber shall be arranged around the cylinder and two litres of kerosene shall then be poured over the timber, in such a manner that it is mainly absorbed by the timber. Paper may be used to assist in the firing of the timber.

The test shall be considered satisfactory when there is at least a 170 kPa increase in the cylinder pressure, prior to release of a fusible plug and when the fusible plug releases within 10 minutes from the time the fire was started.

The cylinder shall be considered satisfactory when there is no appreciable bulging of the shell, no extensive penetration of the filler by decomposition, and no break up of the filling material.

20.7 Failure of Type Tests

If a cylinder fails in any of the type tests given in **20.3**, **20.4**, **20.5** or **20.6**, all the type tests shall be repeated for type approval.

21 MARKING

21.1 General Instructions

a) Each cylinder shall be clearly and permanently marked in accordance with the following conditions by stamping or similar processes on such a part which is inseparately bound with the cylinder which is not or only negligibly affected by stresses due to the gas pressure within it.

b) The name plate shall not be affixed to the cylinder's shoulder if there is a risk of corrosion or embrittlement.

c) In conjunction with the original markings, space shall be provided for stamping the date of the test.

d) Marking shall be legible and their size shall be 6 mm minimum.

e) The stamps used for marking shall have small radii at changes of section to avoid formation of sharp edges in the stamped marking.

21.2 Permanent Marking

Each cylinder shall be permanently marked on the shoulder or on a reinforced part of the cylinder or on the collar or neck ring, provided it can be demonstrated in the bursting test that fracture does not initiate in these markings, with the following permanent marking:

a) The number of this standard;

b) Gas identification 'ACETYLENE' and the chemical symbol C_2H_2;

c) Identification of the manufacturer and owner together with the serial number of the completed cylinder;

d) Identification of the porous mass;

e) Tare weight in kg;

f) Maximum mass of the acetylene to be charged into the cylinder not inclusive of the saturation mass of acetylene in kg;

g) Identification of the solvent when not acetone;

h) Maximum working pressure at 15°C in MPa (*see* **3.3**);

j) Water capacity in litres;

k) Test pressure in MPa;

m) Date of filling of porous mass;

n) A symbol to indicate the nature of heat treatment; and

p) Inspector's official mark.

21.3 BIS Certification Marking

Details are available with the Bureau of Indian Standards.

21.4 Temporary Marking

Each cylinder shall bear a test ring to indicate the last date on which the porous material was examined and found to be satisfactory.

21.5 Colour Identification

Each cylinder shall be given zinc or aluminium metal coating over which it shall be painted in accordance with IS 4379 : 1981 for the identification of the contents.

22 RECORDS

A record shall be kept of all tests made at the cylinder manufacturer's works and copies shall be made available to the inspecting authority and purchaser of the cylinder (if desired). A Test certificate duly approved and signed by the inspecting authority shall be forwarded to the statutory authority and the purchaser.

a) Certificate of analysis covering the material of the sheet of which the particular cylinder was made;

b) Result of the tensile test;

c) Result of the hydrostatic stretch test indicating compliance only;

d) Result of leakage test indicating compliance only;

e) Water capacity in kg;

f) Weight of each cylinder when empty and dry plus those of fusible plugs, valve pad and footring, if any, and any part permanently attached to the cylinder, but not including valve or cap;

g) Weight of complete cylinder, that is, weight of item (f) plus weight of porous filling, but not including valve or cap;

h) Weight of cylinder in item (g) plus weight of saturation gas, solvent at atmospheric pressure and valve, but not including valve cover, if any; and

j) Type of porous filling and percentage porosity of the filling material.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
170 : 1986	Acetone (*third revision*)
226 : 1975	Structural steel (standard quality) (*fifth revision*)
308 : 1988	Dissolved acetylene (gas) (*third revision*)
817 : 1966	Code of practice for training and testing of metal arc welders
1079 : 1988	Hot rolled carbon steel sheet and strip (*fourth revision*)
1182 : 1983	Recommended practice for radiographic examination of fusion welded butt joints in steel plates (*second revision*)
1875 : 1992	Carbon steel billets, blooms, slabs and bars for forgings (*fourth revision*)
2041 : 1982	Steel plates for pressure vessels used at moderate and low temperature (*first revision*)
2062 : 1984	Weldable structural steel (*third revision*)
2595 : 1978	Code for unfired pressure vessels
2825 : 1969	Code of practice for radiographic testing (*third revision*)
3196 (Part 3) : 1991	Welded low carbon steel cylinders exceeding 5 litre water capacity for low pressure liquefiable gases: Part 3 Methods of test (*fourth revision*)
3224 : 1979	Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders (*second revision*)
3657 : 1978	Radiographic image quality indicators (*first revision*)
4379 : 1981	Identification of contents of industrial gas cylinders (*first revision*)
4853 : 1982	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes (*first revision*)
6240 : 1989	Hot rolled steel plate (up to 6 mm) sheet and strip for the manufacture of low pressure liquefiable gas cylinder (*second revision*)
7241 : 1981	Glossary of terms used in gas cylinder technology (*first revision*)
7283 : 1992	Hot-rolled bars for production of bright bars
7285 : 1988	Seamless manganese steel cylinders for permanent and high pressure liquefiable gases (*second revision*)
9550 : 1980	Bright bars
9639 : 1980	Code of practice for visual inspection of newly manufactured low pressure welded steel gas cylinders
10787 : 1984	Hot rolled micro-alloyed steel plate, sheet and strip for manufacture of low pressure liquefiable gas cylinders
13479 : 1992	Fusible plugs for dissolved acetylene gas cylinders — Specification

ANNEX B

(*Clauses* 19.2.3 *and* 20.1.2)

DETERMINATION OF POROSITY OF THE POROUS MASS

B-1 A cylinder filled with the porous mass shall be fitted with a valve and weighed. It shall be subjected to the action of vacuum so that, after standing for 12 hours with the valve closed, the pressure does not exceed 20 torr. It shall be then filled with acetone under a pressure not exceeding 16 kgf/cm². When the acetone no longer penetrates, the valve shall be closed and the cylinder weighed.

B-2 The cylinder shall be again subjected to the action of vacuum for 15 minutes and further acetone admitted. The cycle of operations shall be repeated until all air is expelled from the cylinder and constant weight obtained.

B-3 The cylinder shall be then placed in a room where the temperature is constant, leaving the valve open and connected to a vessel containing acetone, for a period of 24 hours.

B-4 The valve shall be then closed, the acetone container disconnected and the cylinder weighed.

B-5 The difference between the final weight and that of the cylinder before the introduction of the acetone represents the weight of acetone introduced.

B-6 The porosity is given by the following formula:

$$P = 100 \frac{w}{v \times d}$$

where

P = porosity in percentage,

w = weight of acetone introduced in kg,

v = the water capacity of the cylinder in litres without porous mass, and

d = density of acetone at the temperature at which the cylinder is finally weighed in kilogram per litre.

ANNEX C

(*Clause* 19.2.4)

DETERMINATION OF CRUSHING STRENGTH OF THE POROUS MASS

C-1 PRINCIPLE

At ambient temperature, a test piece of specified dimensions is subjected to an increasing load until either the test piece collapses or its height is reduced to 90 percent of its original value. The crushing strength is calculated from the maximum force and the dimensions of the test piece.

C-2 APPARATUS

C-2.1 Mechanical or Hydraulic Crushing Strength Machine that will enable the load to be increased progressively and smoothly, and with a system of measurement that will enable the force exerted on the test piece to be known within ± 2 percent shall be used. One of the platens of the machine shall be mounted on a spherical seating that will compensate for any small error of parallelism between the face of the test piece and the platen. The platens of the machine shall be ground and the lower one shall be marked so as to facilitate placing the test piece at its centre.

C-2.2 Micrometer, or other suitable instrument shall be used to measure the deformation of the test piece.

C-2.3 Equipments to measure the size of each test piece and to verify its geometrical form.

C-2.4 Drying oven, capable of being controlled a 110 ± 5°C.

C-2.5 Desiccator for cooling the specimen.

C-3 TEST PIECES

C-3.1 Section the cylinder tested for porosity according to **19.3.1** into two pieces and recover the porous mass from each half. Discard 50 mm from the top and bottom of the porous mass. From the balance porous mass make one cube each from top, middle and bottom one-third of the mass. Inspect the cubes for voids, cracks, water marks, etc. The cubes shall not have the above said defects.

C-3.2 The sides of test cube shall be of 45 ± 1 mm size.

C-3.3 The load bearing faces of each test pieces shall be parallel within a tolerance of 1 mm. This condition shall be checked by making four measurements of the height of the test piece, one at the centre of each of its four sides; the measurements shall not differ among themselves by more than 1 mm.

C-3.4 The axis of each test piece shall be perpendicular to its base within a tolerance of 1 mm. This condition shall be checked by placing the test piece on a surface table or surface plate and presenting a set square to the centre of each of its four sides; any gap between the set square and the side of the test piece shall not exceed 1 mm.

C-4 PROCEDURE

C-4.1 Measure the sides of each load-bearing face of the test piece to the nearest 0·5 mm.

C-4.2 Dry the test piece to constant mass in the oven, controlled at 110 ± 5°C for a maximum period of 8 hours and cool it to room temperature in a desiccator.

C-4.3 Place the test piece on one of its faces in the centre of the lower platen of the testing machine.

C-4.4 Gradually and continuously increase the load.

C-4.5 Continue increasing the load until the test piece collapses (fails to support the load). Record the maximum load indicated during the test.

C-5 EXPRESSION OF RESULTS

C-5.1 The crushing strength is given, in newtons per square millimetre, by the formula

$$C = \frac{F_{max}}{a^2}$$

where

C = The crushing strength of the porous mass;

F_{max} = The maximum load, in newtons, indicated during the test; and

a = Mean of the four measurements of the each side of the top face, in millimetres.

C-5.2 The crushing strength shall be expressed in newtons per square millimetre, to the nearest 0·1 N/mm^2.

NOTE — The SI unit for crushing strength is the newton per square metre, but the newton per square millimetre has been chosen for practical reasons.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'. Comments on this Indian Standard may be sent to BIS giving the following reference:

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